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(54) **DEVICE FOR COLLECTION OF DEBRIS**

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(57) **ABSTRACT**

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15/104.8, 160, 221; 172/29, 199, 612, 189,  
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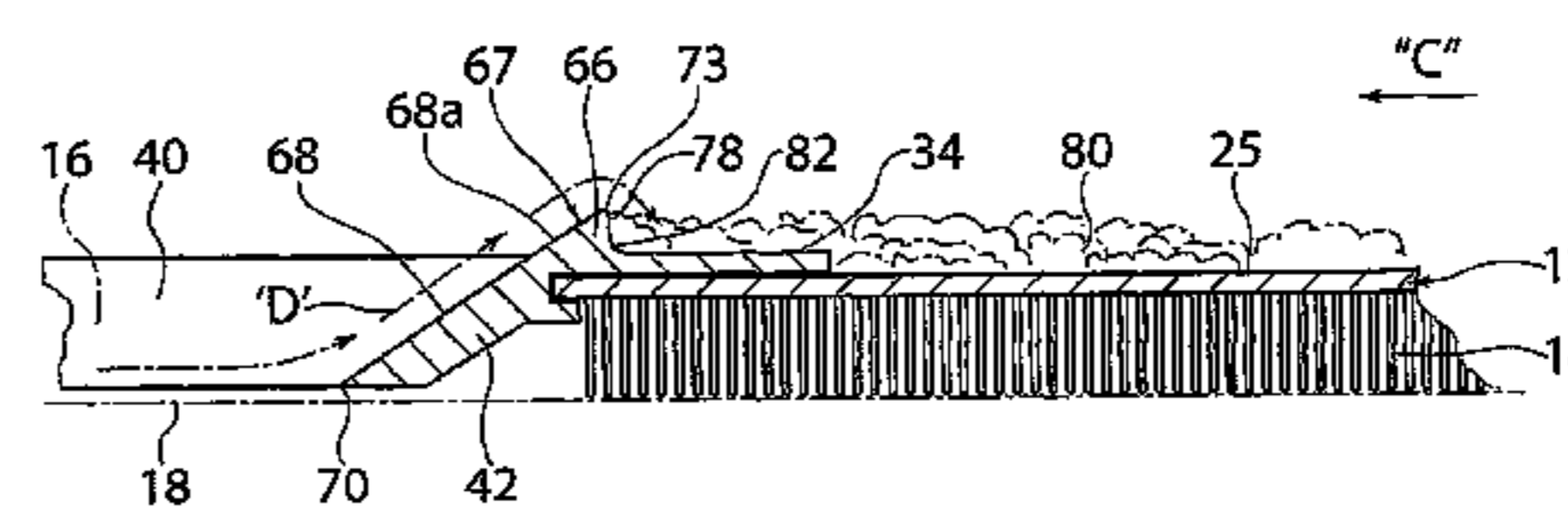
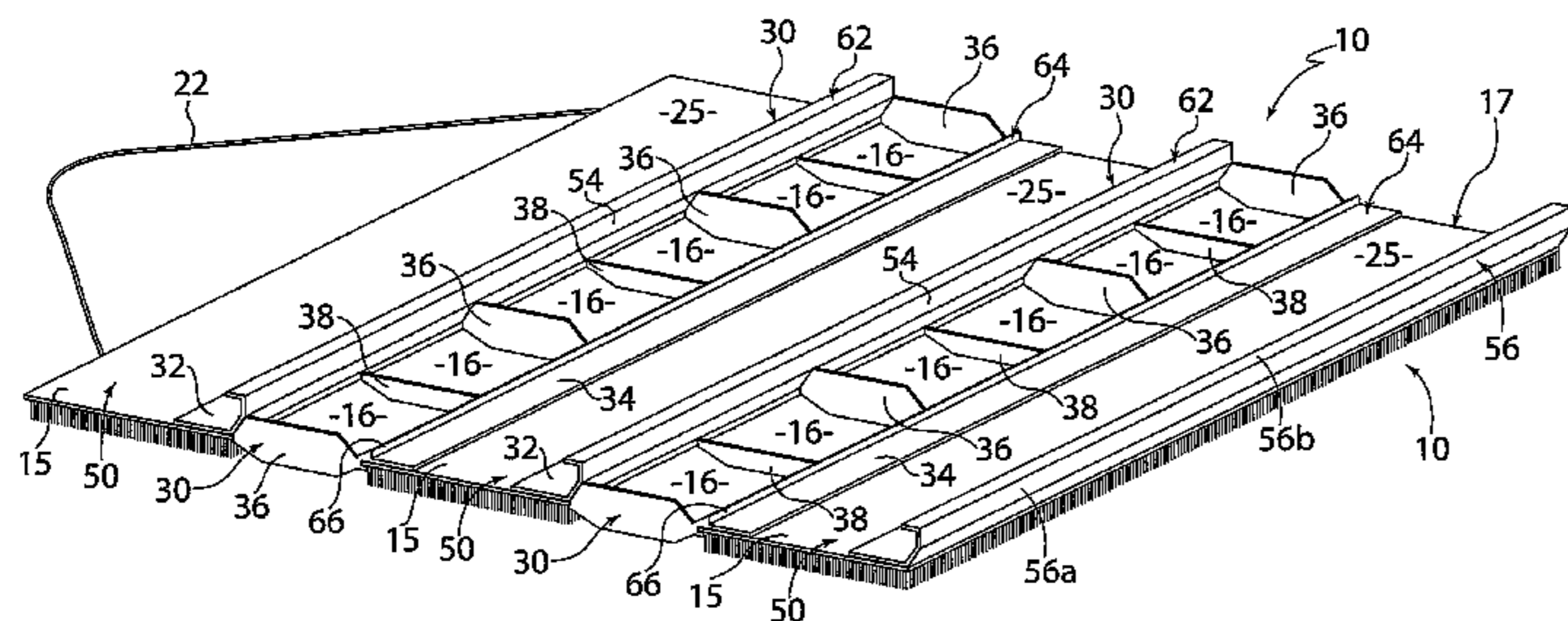
A device (10) for collecting debris from a ground surface (18). A flexible generally planar member (17) has openings (16) therethrough. When the device is laid on and forwardly moved over the ground surface (18) debris on the ground surface passes upwardly through the openings onto collection surfaces (25) of the device. The device has transversely extending barriers (67) positioned whereby, debris passing upwardly through the openings (16) passes upwardly over the barriers (67) and then downwardly to the following collection surface (25). The barriers (67) at least partially obstruct movement of collected debris on the collection surfaces (25) back into the openings (16) under deceleration of the device as it is forwardly moved over the ground surface.

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**9 Claims, 3 Drawing Sheets**



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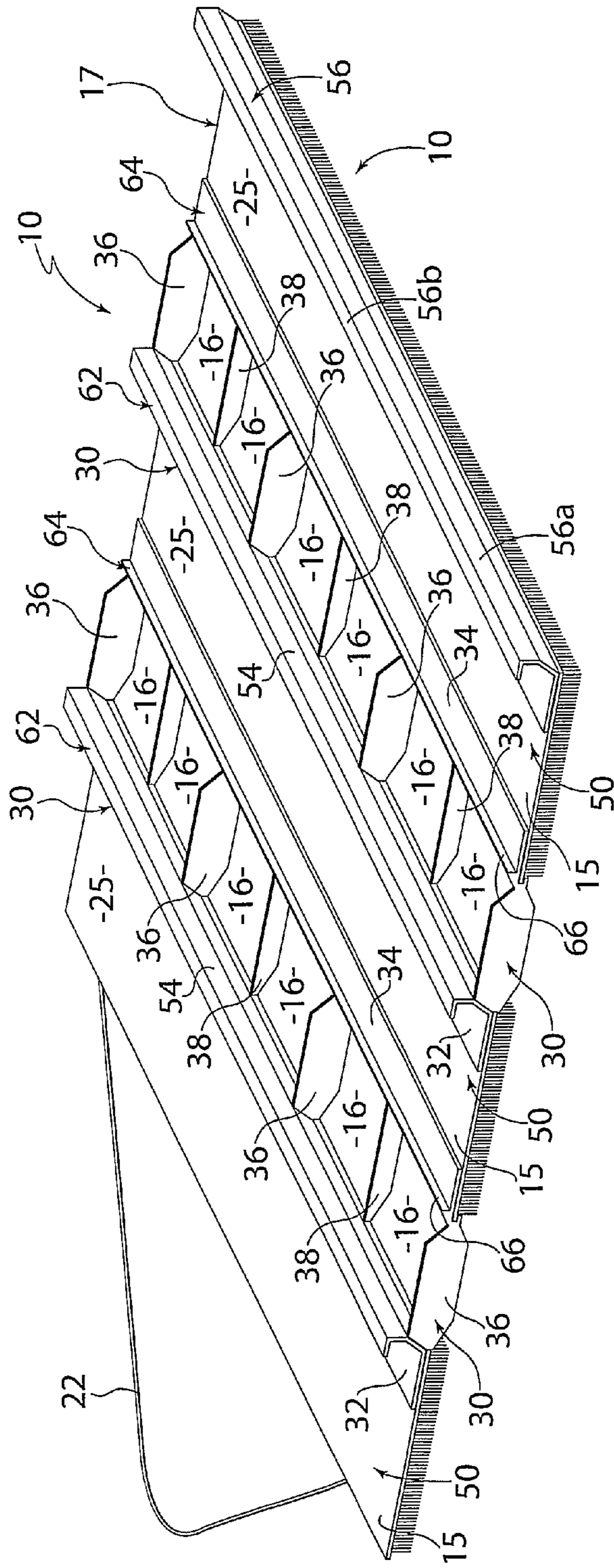


Figure 1

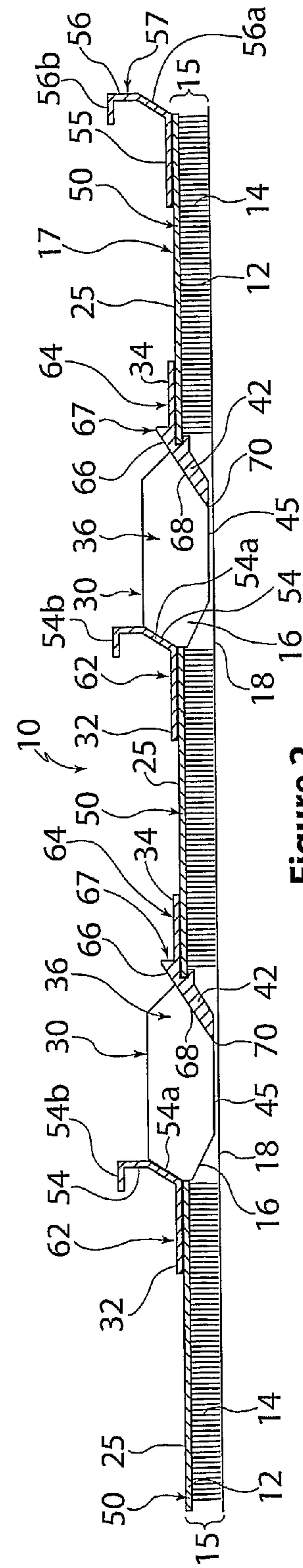
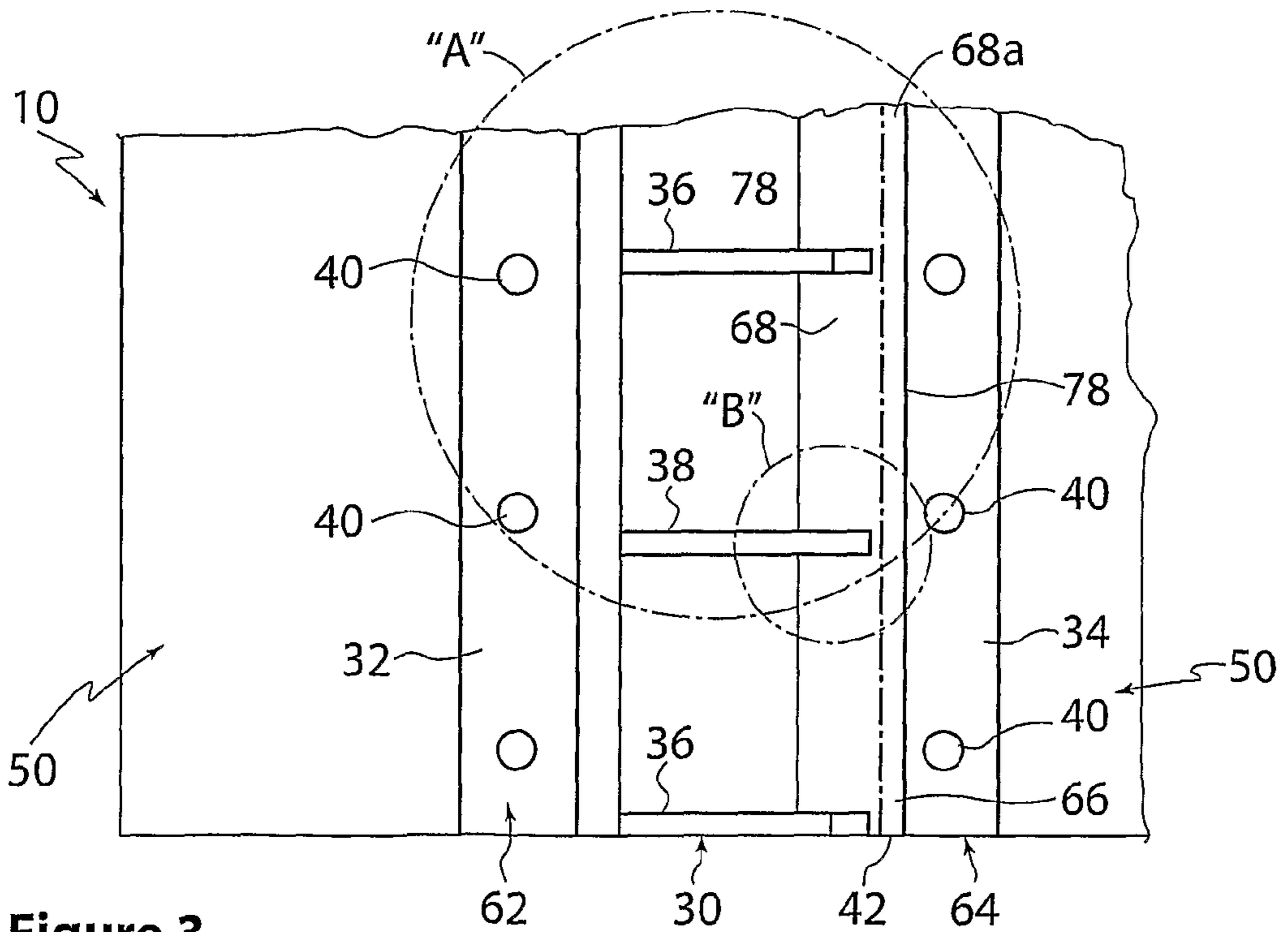
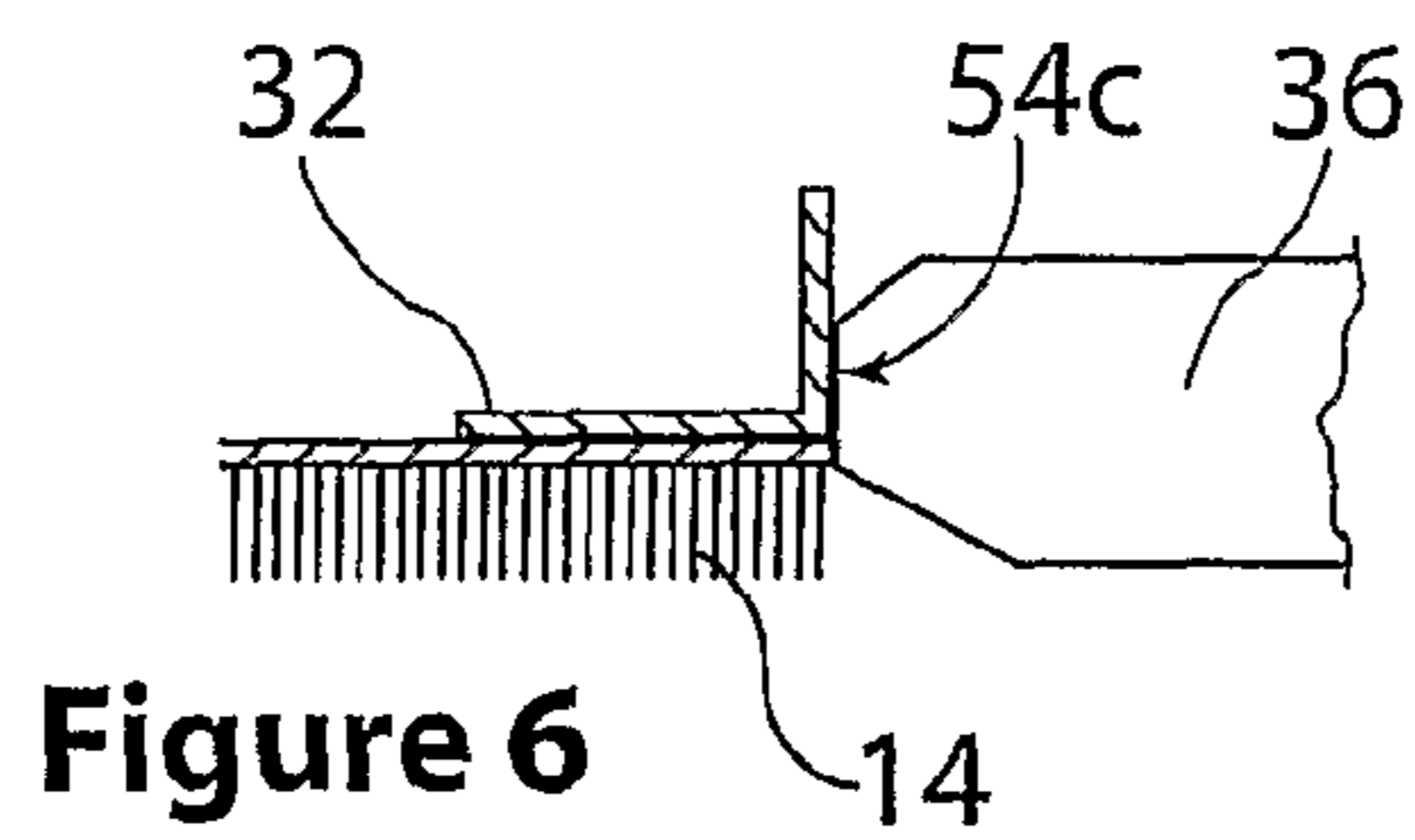
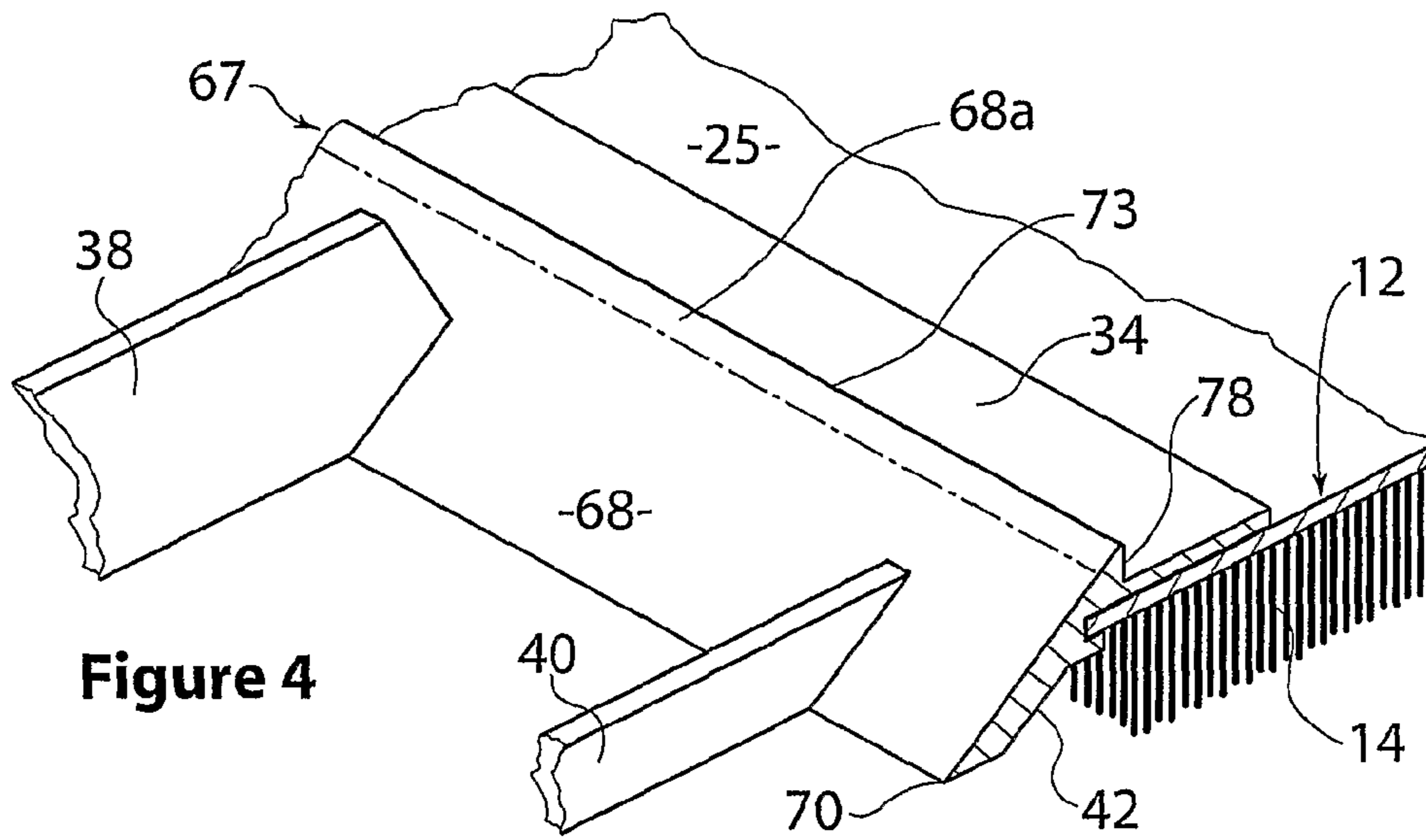


Figure 2



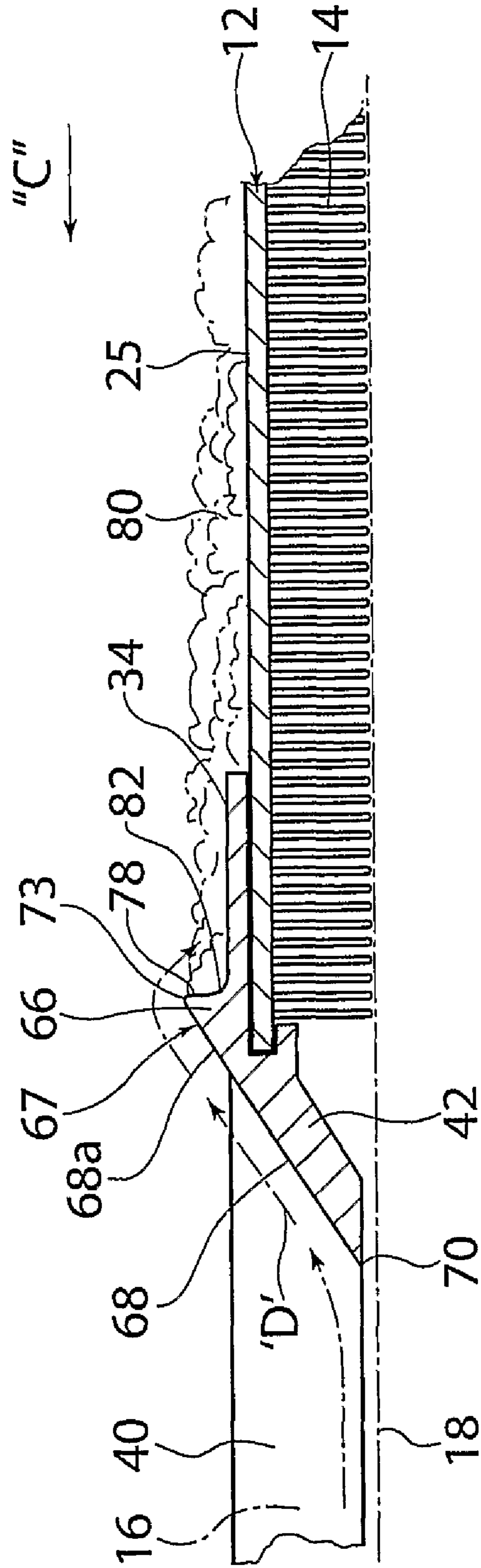


Figure 5

**DEVICE FOR COLLECTION OF DEBRIS**

## FIELD OF THE INVENTION

This invention relates to a device for collection of debris.

## BACKGROUND OF THE INVENTION

U.S. Pat. No. 5,284,211 and International Patent Application No. WO/1996/009440 disclose debris collection devices suitable, for example, for collecting small debris from a ground surface. These are each in the form of a mat-like structure having openings therethrough. The mat-like structure is laid on the ground surface and moved over the surface so the debris passes from the ground surface upwardly through the openings to rest on the upper surface of the structure. The device may then be moved to a suitable location at which the collected debris on the upper surface of the structure is removed, such as by up-ending the device. For example, the device of U.S. Pat. No. 5,284,211 has been found useful for clearing leaves from, and generally grooming, en tout cas tennis courts, and the arrangement of WO/1996/009440 useful for a variety of applications, including clearing debris such as bolts, screws, nuts washers and other foreign object debris, so called "FOD", from aircraft runways.

Arrangements such as shown in U.S. Pat. No. 5,284,211 and international application WO/1996/009440 have been found to be very satisfactory in use, offering a relatively inexpensive alternative to, for example, mechanical sweeping devices using rotary brushes. However, it has been noticed that, sometimes, there is a tendency for collected material on the mat structure to fall back through the openings in it, and be lost again. This tendency particularly occurs under abrupt deceleration of the device when it is being moved over the ground surface. Loss of collection efficiency due to this can be limited by ensuring that this deceleration is always relatively gentle, but it would be advantageous to be freer of this operational constraint.

## SUMMARY OF THE INVENTION

In one aspect, the invention provides a device for collecting debris from a ground surface, comprising a flexible generally planar member with an opening therethrough such that when the device is laid on and forwardly moved over a ground surface debris on the ground surface passes upwardly through the opening onto a collection surface of the device, the device having a transversely extending barrier positioned whereby, in use, debris passing upwardly through the opening passes upwardly over the barrier and then downwardly to the collection surface, the barrier at least partially obstructing movement of collected debris on the collection surface back into the opening under deceleration of the device as it is forwardly moved over the ground surface.

The barrier may be in the form of a transverse wall arranged such that, in an in-use condition of the device, it extends upwardly and is positioned behind and adjacent said opening, and at a forward location with respect to the collection surface.

The wall may have first and second opposed surfaces extending transversely of the device, these being arranged and configured so that in said in use condition the first surface is behind the opening and is inclined to extend upwardly and rearwardly from a lower location to a higher more rearward location, and the second surface is behind the first surface; extending generally downwardly from an upper location to a

lower location adjacent the collection surface, the first surface being disposed to then, in use of the device, facilitate rearward flow of debris from the opening along and up the first surface to be carried under momentum of the debris past the wall to the collection surface, and said second surface acting to at least partially inhibit movement of collected debris back to the opening under deceleration of the device, by pile-up of the material against the second surface.

The first surface may form a substantially continuous surface with an inclined surface extending upwardly and rearwardly from a transverse edge of said opening which, in said in use condition, forms a rear edge of the opening.

The first surface and the second surface may at least substantially meet at an apex of said wall.

The wall may extend to a distance from the collection surface which is in the range 5 mm to 25 mm above the collection surface in the condition for use of the device.

The wall may extend substantially from side to side of the device.

The planar member may define a section thereof, in use being behind the opening, a surface of which section is uppermost in the condition for use of the device and forms the collection surface.

The section may have an underside formed of conformable material so that, in use of the device, the underside may locally conform to undulations in the ground surface.

In one form, the section is formed from a flexible layer having depending bristles.

## BRIEF DESCRIPTION OF THE DRAWINGS

The invention is further described by way of example only with reference to the accompanying drawings in which:

FIG. 1 is a perspective view of a debris collection device constructed in accordance with the invention;

FIG. 2 is fragmentary vertical front to rear cross section of the device of FIG. 1;

FIG. 3 is a fragmentary plan view of the device of FIG. 1;

FIG. 4 is a perspective view of part of the device of FIG. 1, in the region "A" in FIG. 3;

FIG. 5 is an enlarged front to rear upright cross section in the region "B" in FIG. 3; and

FIG. 6 is an enlarged front-to-rear cross sectional view of part of a modified frame structure of the device of FIGS. 1 to 5.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The debris collection device **10** shown is formed as a flexible generally planar member **17** having sections **50** formed from conformable matting material **15** having, as shown in FIG. 2, a flexible laminar base portion **12** with depending bristles **14**. There are three sections **50** arranged at lengthwise spaced locations, separated by two transverse frame structures **30**. It has been found convenient to form the device from inverted artificial grass material of the kind used for the surfaces of tennis courts and the like, arranged with the bristles extending downwardly.

The device **10** has rectangular sidewardly elongate openings **16**, there being a respective transversely extending row of the openings defined by each frame structure **30**. When the device **10** is moved over a ground surface **18** (FIG. 2), such as by towing by use of a rope **22** at a forward end thereof, the bristles **14** agitate leaves, stones and the like on the ground surface by contact therewith and this debris tends to pass from the underside of the device **10** through the openings **16** to rest

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on upper collection surfaces **25** of sections **50**. The debris so resting on the upper side of the device **10** can be then conveniently taken away on the device for disposal as desired.

In the illustrated embodiment, there are six openings **16** formed in each frame structure **30**. Rows of the openings **16** in each of the frame structure **30** are respectively interposed, in the front-to-rear direction, between forward and intermediate ones of the sections **50**, and the intermediate and rear ones of sections **50**.

A leading frame structure **30** is secured at a transverse leading edge portion **32** thereof to a transverse trailing edge portion of a forward one of the sections **50**, and at a trailing edge portion **34** to the a leading edge portion of an intermediately positioned one of the sections **50**. A trailing frame structure **30** is secured at transverse leading and trailing edge portions **32, 34** respectively to a transverse trailing edge portion of the intermediately positioned section **50**, and to a transverse leading edge portion of a trailing section **50**.

The frame structures **30** may for example be secured to the sections **50** by use of bolts or other fixture elements **40** (FIG. **3**), which extend through the edge portions **32, 34** of the frame structures **30** and the matting material **15**. Alternatively, the sections might for example be stitched to the edge portions **32, 34**.

Edge portions **32, 34** are formed as respective forwardly and rearwardly extending parts of leading and trailing transverse elements **62, 64** of the respective frame structure **30**, and are generally coplanar. The edge portions **32, 34** overlie the respective adjacent upper edge portions of sections **50** to which they are secured.

The openings **16** in each frame are defined between the leading and trailing transverse elements **62, 64** thereof and front to rear extending fin-like walls **36, 38** of each frame structure. Walls **36, 38** extend between and interconnect the transverse elements **62, 64**. There are, in the illustrated device **10**, four walls **36** for each frame structure **30**, one outer one at each lateral side of the respective frame structure **30**, and two inner ones positioned at locations one third of the distance inwards from a respective one of the outer walls **36**. Each frame structure has three walls **38**, each positioned midway between pairs of the walls **36**. Walls **36, 38** are generally planar and vertically extending, and of relatively small thickness in the side to side direction of the device **10**.

Each wall **36, 38** has a lower edge portion **45** which in the in-use position of the device **10**, is parallel to and either rests on or is just above the ground surface **18**. Walls **38** are of comparatively lesser height than walls **36**, but are otherwise of similar form to walls **36**.

Trailing edges of the openings **16** of each frame structure **30** are defined by portions of the leading edge **70** of a transverse sloping pick-up portion **42** formed on the respective trailing transverse element **64**. Each pick-up portion **42** has a front surface **68** that extends upwardly and rearwardly from the respective edge **70** at an acute angle to the ground surface **18**. The pick-up portions join at the upper rear with forward parts of the portions **34** of the respective transverse element **64**. The upper part of each pick-up portion **42** defines an upstanding wall **66** which terminates a short distance above the upper surface of the trailing edge portion **34** of the respective frame structure **30**, and thus also a short distance above the upper surface **25** of the following section **50**. Each wall **66** has an upwardly and rearwardly extending sloping front surface **68a** (FIGS. **4** and **5**) forming a continuation of the sloping upper surface **68** of the respective pick-up portion **42**. The upper edge of each surface **68a** terminates at an apex **73** of the respective wall **66**. A rear surface **78** of each wall **66** extends

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downwardly from apex **73** to the edge portion **34** of the respective frame structure **30**, and substantially notivally thereto.

Each forward transverse element **62** has an upstanding wall **54**. Wall **54** has a generally upright part **54a** extending upwardly from the rear edge of portion **32** and a part **54b** that extends forwardly from the upper end of part **54a** hereof. At the upper rear margin of the rearmost section **50**, there is provided a side to side extending member **57**, having a transversely extending flat portion **55** secured to the rear side to side margin of section **50** and having at the rear edge thereof an upstanding wall **56** similar to walls **54**, having an upright part **56a** extending upwardly from the rear edge of portion **32** and a part **56b** that extends forwardly from the upper end of part **56a**.

The walls **54, 56** present barriers serving to inhibit rearward movement of collected debris off the mat sections **50** during use of the device **10**, so as to lessen loss of collected material from the device. That is, as collected debris accumulates on the surfaces **25**, there is a tendency for this debris to move rearwardly, due to the continuing forward movements of the device **10**, and the walls **54, 56** restrict movement of the collected debris back over the rear edges of the collection surfaces. The walls **66** serve to inhibit forward movement of collected debris **80** from the intermediate and rear mat sections **50** from passing forwardly back into the openings **16** immediately in front thereof, during deceleration of the device **10** as it is used. In particular, under deceleration, during forward movement of device **10**, resultant forward movement of the collected debris **80** along collection surfaces **25**, in the direction "C" in FIG. **5**, is at least in part obstructed by piling up of the debris **80** against the upstanding wall surfaces **78**. On the other hand, the sloping front surfaces **68a** of the walls **66** facilitate flow of debris **80** picked up by the device to pass upwardly and rearwardly along the pick-up portions **42**, upwardly of rearwardly to clear the apexes **73** of the walls **66** to fall and be collected on the collection surfaces **25** of the intermediate and rear mat sections **50**. This movement of debris along surface **68** of pick-up portions **42** and over the adjacent wall **66** is illustrated by path "D" in FIG. **5**. By this, the walls **66** form respective barriers **67** to impede forward movement of collected debris, while permitting rearward flow thereover to the collection surfaces.

The described device has been found to be particularly satisfactory for cleaning debris from hard surfaces such as asphalt, concrete or the like, as well as from grass and similar surfaces. It has also been found satisfactory for use in collecting small items such as nuts, bolts or the like such as from aircraft runways. With rough asphalt in particular, the collecting action is very efficient, the bristles **14** acting to clean the ground surface, directing debris to the upper surface of the device.

In one foam of the invention, it was found satisfactory to provide openings **16** of dimensions of the order of 260 mm by 60 mm width in front rear length, with the depth of the pile formed by the bristles **14** being of the order of 1 cm. The sizes may however be varied as necessary to adapt the invention to particular uses. For example, the openings **16** may be of the order of 10 to 300 mm length, measured in the front to rear direction of the device of the invention. At towing speeds of up to 30 Kph, a length of about 70 mm may be satisfactory, with greater lengths being employed with faster towing speeds, for example 100 mm where speeds up to 100 Kph are employed. Similarly, the depth of the pile provided by the bristles **14** may be varied. Generally, the longer the bristles, the better is the wearability, but shorter bristles are generally more efficient, since it is easier to direct objects through a

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lesser distance from the ground surface to the upper surface of the device. Practically, for small objects such as washers or the like a pile thickness of about 9 mm may be satisfactory. For large objects, greater depth may be employed. A choice of overall thickness of matting material of 5 to 15 mm will provide satisfactory pick-up of a range of commonly encountered small objects.

The bristles **14** should generally be flexible, and some degree of resilience is also desirable.

In an exemplary construction, the matting material **15** is artificial grass material, the bristles **14** being formed of polypropylene fibres and about 10 mm in length. The resultant mat-like structure is crushable by impression of hand pressure on the bristles (i.e. upwardly crushable), but has sufficient resilient to cause reasonably quick restoration to the original condition when pressure is removed. This artificial grass material is relatively flexible, the base material being flexible.

The described artificial matting material presents an under-surface constituted by the bristles which is readily able to conform to local variations in ground surface as the device **10** is passed over the ground surface, in particular being able to conform to surface undulations as well as accommodating small obstacles, and providing an effective sweeping action to agitate debris and cause it to move through the openings **16**. While it is preferred that the device include a flexible base with a conformable portion in the form of the described bristles, other constructions are possible. For example, a layer of foamed plastics material could be used. In general, the whole of the device **10** should be flexible, although, particularly if a very thick under layer constituted by bristles, foam or other material is employed, this could be secured to a relatively rigid upper backing. The leading edge of the device may be provided with a rigid element to facilitate maintenance of the device in a spread out condition during towing over a surface.

The configuration and height of the wall **66** may be chosen to suit that particular kind of debris to be collected. For general use, a height of between 5-25 mm may be useful.

In general, the height may be greater for larger types of material to be collected and smaller for smaller types of material. That is, smaller types of material may have lesser forward momentum when collected, so that forward movement under deceleration of the device may be more easily resisted. Also, the relatively greater momentum of heavier material when passing upwardly from openings **16** may enable them to be efficiently carried rearwardly over a higher barrier **67**.

The walls **54** may be alternatively formed as simple transverse upstanding elements **54c** as shown in FIG. **6**, and wall **56** may be similarly formed.

As shown in FIG. **5**, the walls **66** forming barriers **67** preferably join to the respective edge portions **34** at respective radiused fillet portions **82**, so that the rear surfaces **78** of walls **66** merge smoothly with the upper surface of the respective portion **34**. By this, root portions of the walls **66** are of greater width viewed in transverse section as in FIG. **5**, and there is no sharp corner between these surfaces. This aids in strengthening the walls **66**. Also, the arrangement assists by inhibiting catching of debris in the corners between surfaces **78** and surfaces of edge portion **34**, when the device **10** is lifted to shake debris forwardly and out of the device **10**.

In general, the dimension of the openings **16** in the front to rear direction of the device may be about the same or slightly greater than the front to rear lengths of the sections **50**. The device may be of any convenient dimensions. A length of the

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order of 1.5 meter and a width of the order of 2.4 meters may be satisfactory for general manual use.

The described construction has been advanced merely by way of example and many modifications and variations may be made without departing from the spirit and scope of the invention, which includes every novel feature and combination of features herein disclosed.

Throughout this specification and the claims which follow, unless the context requires otherwise, the word "comprise", and variations such as "comprises" and "comprising", will be understood to imply the inclusion of a stated integer or step or group of integers or steps but not the exclusion of any other integer or step or group of integers or steps.

The reference in this specification to any prior publication (or information derived from it), or to any matter which is known, is not, and should not be taken as an acknowledgment or admission or any form of suggestion that that prior publication (or information derived from it) or known matter forms part of the common general knowledge.

The invention claimed is:

**1.** A device for collecting debris from a ground surface, comprising a flexible generally planar member with an opening therethrough such that when the device is laid on and forwardly moved over the ground surface debris on the ground surface passes upwardly through the opening onto a collection surface of the device, the device having a transversely extending barrier positioned whereby, in use, debris passing upwardly through the opening passes upwardly over the barrier and then downwardly to the collection surface, the barrier at least partially obstructing movement of collected debris on the collection surface back into the opening under deceleration of the device as it is forwardly moved over the ground surface,

the barrier being in the form of a transverse wall arranged such that in an in-use condition of the device, it extends upwardly and is positioned behind and adjacent said opening, and at a forward location with respect to the collection surface,

said wall having first and second opposed surfaces extending transversely of the device, these being arranged and configured so that in said in use condition the first surface is behind the opening and is inclined to extend upwardly and rearwardly from a lower location to a higher more rearward location, and the second surface is behind the first surface, extending generally downwardly substantially normally to the collection surface from an upper location to a lower location adjacent the collection surface the first surface being disposed to then, in use of the device, facilitate rearward flow of debris from the opening along and up the first surface to be carried under momentum of the debris past the wall to the collection surface, and said second surface acting to at least partially inhibit movement of collected debris back to the opening under deceleration of the device, by pile-up of the material against the second surface.

**2.** A device as claimed in claim **1** wherein the first surface forms a substantially continuous surface with an inclined surface extending upwardly and rearwardly from a transverse edge of said opening which, in said in use condition, forms a rear edge of the opening.

**3.** A device as claimed in claim **1** wherein said first surface and said second surface at least substantially meet at an apex of said wall.

**4.** A device as claimed in claim **1** wherein the wall extends to a distance from the collection surface which is in the range 5-25 mm above the collection surface in the condition for use of the device.



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5. A device as claimed in claim 1 wherein the wall extends substantially from side to side of the device.

6. A device as claimed in claim 1 wherein the planar member defines a section thereof, in use being behind the opening, a surface of which section is uppermost in the condition for use of the device and forms the collection surface.

7. A device as claimed in claim 6 wherein the section has an underside formed of conformable material so that, in use of the device, the underside may locally conform to undulations in the ground surface.

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8. A device as claimed in claim 7 wherein the section is formed from a flexible layer having depending bristles.

9. A device as claimed in claim 1, wherein said second surface at a lower location includes a convex surface portion which extends downwardly and rearwardly so that the wall has a thickened lower root portion.

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